The Mining Journal
AND COMMERCIAL GAZETTE.

SUPPLEMENT—VIII.

REVIEWS.

On the Use of Hot Air in the Iron-Works of England and Scotland. Translated from a Report made to the Director-General of Mines in France, by M. DUFRENOY, in 1834. Murray, Albemarle-street, 1836.

The iron manufacture is a subject of such immense importance in this country, that every project for its improvement is deserving of the most attentive consideration. This remark applies very forcibly to the introduction of the "*hot-air blast*," which has not only produced very important effects in the districts where it has been tried, but promises, at no distant period, to come into such general use, as to effect a change of considerable importance in the iron-trade of this country.

In the various processes employed in making iron, an intense degree of heat must be employed, in order to produce the decomposition of the ore and fusion of the metal; and an immense consumption of coal thus becomes necessary—a consumption which is still further increased by the necessity of converting the coal into *coke*, before it can be used in the furnace—an operation by which much of the calorific power of the coal is entirely lost. It thus happens that to produce a single ton of iron, there must be a consumption of from four to five tons of coal (in some cases even more); a circumstance which renders it impossible to carry on the iron manufacture in any other situation than the immediate vicinity of coal mines. It is on this account that in South Wales, in Staffordshire, Shropshire, and other districts where iron is made, the blast furnaces will invariably be seen rising in the midst of coal pits and coke fires, a circumstance which must have been noticed by almost every person who has travelled through these parts of the country, as this combination produces an effect which, especially at night, is well calculated to impress itself upon the mind of a stranger.

The neighbourhood of Glasgow has long been celebrated as the great seat of the iron manufacture in Scotland, and contains rich and extensive deposits of all the mineral substances required for the purpose, or iron-stone, coal, and limestone. Notwithstanding these favourable circumstances, a natural disadvantage was found to exist, which greatly impeded the prosperity of the iron-works, as the coal was of a nature that would not bear *coking* without considerable loss, and, consequently, the expenditure of fuel in making iron greatly exceeded that of other districts, rendering competition both difficult and precarious.

In a district thus situated, it was natural that any suggestion for improvement should meet with more than ordinary attention, and be tried experimentally, with more than common energy; and such we find to have been the case as regards the "hot-air blast," thus giving rise to an extraordinary and unlooked-for amelioration in this important manufacture. The first idea of this contrivance was suggested about six or seven years ago, by Mr. Neilson, the manager of one of the gas-works in Glasgow, and being borne out as to the correctness of his views by some experiments on a small scale, arrangements were made for giving the plan a fair and practical trial at the Clyde iron-works, where its success was soon established beyond a doubt, and a considerable saving of fuel, with other concomitant advantages, was thereby effected.

When this process had been for some time used on a large scale, and by repeated experiments, greatly improved in its application, another very important fact was discovered—that *coking was unnecessary, raw coal being found to answer even better than coke.*

In the course of about three years after its first introduction, the hot-air blast had undergone several successive improvements at the Clyde iron-works, and the great value of this new principle had become so apparent, that in spite of considerable prejudice, and the expense of the patent, it began to be adopted in several other districts. The attention of the French Government was about this time directed to the subject, and M. Dufrenoy was, in consequence, dispatched to this country to visit the establishments in which the hot blast was used, and to investigate the processes employed, with a view to its introduction in the iron-works of France, where, as well as in some other parts of the continent, the principle had already been partially tried, but, owing to some causes which required explanation, had not been attended with the successful results that were anticipated.

M. Dufrenoy accordingly visited this country in 1834, and after seeing the various iron-works using the hot blast, and collecting much information on the subject, on his return drew up the report, of which a translation is now before us, and which contains a further account of the trials of this principle, which have been made in France.

M. Dufrenoy observes, "previous to entering upon this description, I ought to acknowledge the gratitude I feel towards the proprietors of the works I have visited, almost all of whom have afforded the means of examining their establishments minutely, proving thereby that the only rivalry existing between France and England, is in the desire of improvement." We quote with pleasure this acknowledgment of the liberal feeling which prevails among the manufacturers of this country, contrasting, as it does, with the narrow jealousy and national prejudice, which, till a late period, have too generally been manifested towards our continental neighbours.

We now proceed to notice the mode of using the hot blast in the various iron-works where it has been adopted, and the results which have attended it. Referring to the different stages of the experiment, and the results obtained, we make the following extract from M. Dufrenoy's work:—

"To give a better idea of the progressive saving made at the Clyde works, the proportionate quantity of coal and limestone consumed in each of three several experiments is here subjoined.

	t. ct.	t. ct.
"In 1829, the combustion being produced by cold air,—		
"Coal: 1. For fusion, 3 tons of coke, corresponding with	6 13	
2. For the blowing engine	1 0	—7 13
"Limestone		10½
"In 1831, the furnaces being blown with air, heated to 450 degrees Fahr., coke being still used for the fusion of minerals,—		
"Coal: 1. For fusion, 1 ton 18 cwt of coke, corresponding with	4 6	
2. For the hot-air apparatus	5	
3. For the blowing machine	7	—4 18
"Limestone		9
"In July, 1833, the temperature of the air was raised to 612 degrees Fahr., and the fusion was entirely effected by raw coal,—		
"Coal: 1. For fusion	2 0	
2. For the hot-air apparatus	8	
3. For the blowing engine	11	—2 19
"Limestone		7

"At this period the use of hot air had increased the make of the furnaces by more than one-third, and had consequently produced a great saving of expense in the article of labour. The quantity of blast necessary for the furnaces was also sensibly diminished; as a blowing engine of seventy-horse power, which, in 1829, served only for three blast furnaces, was sufficient for the supply of four.

"On comparing these several results, we find that the saving of fuel is in proportion to the temperature to which the air is raised. As for the actual saving, it varies in every work according to the nature of the coal, and the care with which the operation is conducted."

M. Dufrenoy proceeds to observe—

"Notwithstanding the complete success of these experiments, the introduction of heated air into iron-works has had many difficulties to encounter. It has been necessary to overcome, not only the force of habit, but the general prejudice that coal is sulphureous; and that its conversion into coke is not only favourable to combustion in blast furnaces, but is even indispensable in the manufacture of pig iron of good quality.

"This process, though it has been four years in use in the works near Glasgow (which it has rescued from certain ruin), has scarcely passed the borders of Scotland; the miraculous advantages, however, which it has produced, are beginning to triumph over these prejudices, and gradually to extend its use into the different English iron districts. There are one-and-twenty works, containing altogether sixty-seven blast furnaces in which hot air is used. The pig iron made in these furnaces is generally No. 1, and is fit for making the most delicate castings. This process is equally applicable to pigs intended for the manufacture of bar iron; as in order to obtain this quality of iron, it is only necessary to alter the proportion of fuel and mineral. In the forges of the Tyne iron-works, near Newcastle, and of Codnor Park, near Derby, pigs made in furnaces blown by hot air are alone used in the manufacture of bar iron.

"Raw coal has been substituted for coke in most of the establishments I have mentioned. In some, where this plan has not yet been adopted (as at the Monkland iron-works, near Glasgow), I have been informed, that the temperature of the air is not sufficiently elevated to dispense with the use of coke. In some others (as near Newcastle) the extremely bituminous quality of the coal appears to be an obstacle to the use of it in its natural state.

"The hot-air system is not yet introduced into the great works of Merthyr Tydvil, in Wales. Its adoption is there retarded by the comparatively small consumption of coal, as I shall show at the end of this report, and by the high price required for the use of the patent; but I have no doubt that the process would, in that country, be equally productive of a considerable saving in the consumption of fuel."

M. Dufrenoy's work is illustrated by several plates, showing the different modes of applying the hot blast, and without these, elaborate explanations would be almost useless; we shall, however, endeavour to describe the process made use of at the Clyde iron-works, where it was first introduced, the principle being the same in other works, although somewhat modified in its application.

A flue, of a peculiar and rather complicated form, is constructed, nearly surrounding three sides of the furnace, and at the same level as the tuyeres. The pipes conducting the blast from the blowing cylinder to the tuyeres, pass through this flue, which contains five small furnaces, placed at intervals, by which the air becomes heated in its passage; and to prevent its cooling previous to entering the blast furnace, one of these small furnaces is placed as near as possible to each of the tuyeres. The pipes are arranged so as to convey the hot air equally to the tuyere on each side of the furnace, and they are protected from the action of the small heating fires by a casing of brick-work, extending rather more than the length of each furnace. With reference to the management of the hot blast, and the results obtained from it, at the works we are considering, M. Dufrenoy makes the following observations:—

"In the tuyere pipe a small hole is made, by means of which the heat of the air may be ascertained at any moment. This precaution is indispensable, it being essential to the beneficial use of hot air, that it be kept to a high and uniform temperature. With this apparatus the air is raised to 612 degrees Fahr., which is a greater heat, by several degrees, than is necessary for the fusion of lead.

"Two of the four blast furnaces at the Clyde works have an apparatus similar to that which I have described; and, as the situation of the other two does not admit of the pipes being disposed in the same manner, they are doubled over one another.

"Furnaces blown with hot air do not require any extraordinary management; the operation of working them is exactly the same as it was before the introduction of this process, the only difference consisting in the substitution of raw coal for coke. This substitution did not immediataly follow the adoption of the new process. It was not until long after, and when the temperature of the air was raised above the fusion of lead, that this great improvement took place; and it was from that period that the expense was diminished in so large a proportion. It appears, or at least the idea generally prevails in Scotland, that some certain qualities of coal can only be employed when the air is strongly heated. I have already mentioned that in the Monkland iron-works, where the temperature is only carried to from 460 to 490 degrees Fahr. coke is still in use.

"The descent of the minerals in the furnace is very regular; they are charged at nearly equal distances of time, the sinking at the tunnel head being the filler's only guide. As the produce of the uncalcined minerals varies from twenty-two to thirty-four per cent. the composition of the charges ought to follow these variations. At the time of my visit at this establishment, the average of the minerals was forty-four per cent. after calcination, and the charges were composed of 660 lbs. of coal, 520 lbs. of calcined ore, and 100 lbs. of limestone.

"Forty of these charges were usually put in, in twenty-four hours. During the two days that I attended to the progress of the Clyde works, the number of charges was—

July 4, from 6 A.M. to 6 P.M.	38	July 6, from 6 A.M. to 6 P.M.	37
,, 6 P.M. ,, 6 A.M.	39	,, 6 P.M. ,, 6 A.M.	40

"The produce of the furnace in the four *scars*, was 4 tons 8 cwt., 4 tons 9 cwt., 4 tons 6 cwt., and 4 tons 12 cwt., which makes 17 tons 15 cwt. to 154 charges, or 8 tons 17½ cwt. in 24 hours.

"It appears from these data that, on an average, a ton of pig iron requires 4856 lbs of coal, or 2 tons 8½ cwt. The consumption of the hot-air apparatus is 8 cwt. to the ton of pig iron, which raises the total quantity to 2 tons 16½ cwt. say about 2¾ tons to the ton of pig iron."

M. Dufrenoy states that the castings take place every twelve hours, and that the iron obtained is generally a mixture of No. 1 and No. 2; the No. 1 iron being that which issues from the furnace when first tapped.

The account of the Clyde works is concluded by several tables, showing minutely the consumption and produce of the furnaces for the space of one month, both worked in the old manner, with cold air and coke, in 1829; and on the new principle, or with hot air and raw coal, in 1833. A corresponding table is given, stating the cost price of a ton of pig-iron made by each process, from which it appears that, in 1829, the cost per ton was 3*l.* 17*s.* 3d., while in 1833, when the new system was in full operation, it had been reduced to 2*l.* 13*s.*, showing the enormous reduction of 1*l.* 4*s.* 3d., or nearly one-third.

M. Dufrenoy proceeds to give a similar description of the Calder iron-works, near Glasgow, where the use of hot air has been adopted with considerable success, although somewhat differently applied. After minutely describing the process, and giving similar tables of the consumption and yield of the furnaces, to those above referred to, he gives the following summary of the results:—

"Thus the consumption of fuel has diminished in the proportion of 7 to 17 cwt. to 2 tons 2 cwt. There has also been a great diminution of expense in limestone, of which only 5½ cwt. are now used, instead of 13 cwt. which were used in 1828. This decrease results, as I have already said, from the high temperature which the furnace has acquired since the introduction of hot air. I shall point to you at the end of this report, the reasons which induce me to conceive that there is an increase of temperature in the furnace, although we have no means of measuring it.

"The quantity of blast has been reduced from 3500 cubic feet per minute, to 2627 cubic feet; the pressure has been very little altered, it is reduced from 3½ to 2¾ lbs.

"The consumption of coal for the apparatus, varies from 7 to 8 cwt. to the ton of pig iron.

"The consumption of the blast engine remains the same; but as it blows an additional furnace, and as the quantity produced has been increased from 5 to 12 cwt. to 8 tons 4 cwt. it is in fact reduced from 1 ton 4 cwt. to 14 cwt. to the ton of pig iron. (*Slack* alone is used for the purpose.)

"The consumption of ore has sustained some remarkable variations, but the furnace cinders never containing more than from .02 to .015 of iron, it depends very much upon whether ball or flat ironstone is used.

"At Calder as well as at the Clyde works, the daily produce of pig iron has been very much increased; say from 5 tons 12 cwt. to 8 tons 4 cwt.

"This circumstance has a considerable effect on the cost of pig iron, as may be seen by the following table."

It appears from the table referred to, that the cost of a ton of pig-iron at the Calder iron-works, under the old system, was 3*l.* 16*s.* 7d., while, under the new system, using hot air and raw coal, the expense was reduced to 2*l.* 10*s.* 8d., showing a decrease of 1*l.* 5*s.* 11d., being rather more than one-third, and therefore even exceeding the reduction effected at the Clyde works.

The Monkland iron-works, near Airdrie, are next noticed. At the time of M. Dufrenoy's visit, the air was only heated to 450 degrees Fahrenheit, and coke was still used for smelting. The result of the experiment will best be understood from the following extract:—

"The saving of coal and limestone at these works is nearly the same as at Calder, when the air was only heated to 300 degrees Fahr., and when coke was still used in the furnaces. Indeed, before the introduction of the hot-air process, from 7 to 8 tons of coals to the ton of pig iron were used at the Monkland works; since that period the quantities of materials used have been

"Four tons of coal to the blast furnace.
"Six cwt. for the apparatus for heating the air.
"Three ton and a half of raw mine.
"Half a ton of limestone.
"The daily produce of the blast furnace is now 6 tons.
"The pressure of the blast is now 2½ lbs. It was 3 lbs.
"The pig iron produced in the three iron-works of which I have given the details, is chiefly intended for castings. The No. 3, pig iron alone is made into bar iron, and is sold for that purpose to the forges of Newcastle."

At the period we are considering (1834), it appears that there were three other iron-works in Scotland, in which the hot blast had been introduced, and in each attended with similar results to those which have been described.

The introduction of this principle into the iron-works of England and Wales being comparatively recent, the results obtained, although in some cases very successful, are generally less conclusive than those previously noticed, probably owing to local circumstances, as well as peculiarities of the ore and coal, prevailing in almost every iron district.

We may observe, however, that at the Butterley iron-works, in Derbyshire, a saving in fuel of *one-half* had been effected by the hot-air process. In Staffordshire the process, although but recently introduced, at the date of M. Dufrenoy's report, had been attended with considerable success, and it has latterly been adopted in many of the iron-works, in most cases, as we have reason to believe, with great advantage. The information with regard to the Welsh iron-works, which had been the last of all to introduce the hot blast, is short and inconclusive, and, as it appears from the Translator's notes, that M. Dufrenoy's statement is in some respects erroneous, we pass it without notice.

The use of hot air in iron-foundries is next described, and it appears that at Wednesbury, in Staffordshire, some advantages have been obtained by this plan, as a "casting which now occupies twenty minutes, required forty, previous to its adoption." M. Dufrenoy also states that, at the same works, "one cwt. of pig-iron, which with the cold blast required twenty pounds of coke, consumes only thirteen, since the cupolas have been blown with hot air." A detailed account is given of the patent apparatus constructed by Messrs. Jeffries and Paton, of Southwark, for applying the hot blast to the cupolas of iron foundries; and the description is illustrated by a plate, showing the nature of this and some other applications.

From the account of the trials of the hot blast in the iron-works of France, we extract the following passages:—

"Several of the French iron masters have for some months attempted to introduce the hot-air process into their works; M. Boigues, who has so powerfully contributed to the progress of the manufacture of iron, by the construction of a beautiful forge on the Englı h system at Fourchambault (in Nièvre), also made the first attempt to introduce hot air. Several other works, as those of Vienna (in Isere), of La Voulte (in Ardèche), of Rieuperoux (near Grenoble), have also adopted this process.

"The apparatus constructed by M. Boigues exhibits a long range of pipes, like that at Clyde. The furnace of Torteron (in Cher), to which he has applied this process, is fed by a mixture of charcoal and coke. The application of hot air in this furnace has not produced (as was expected) a saving of fuel; but the nature of the pig iron was completely changed. From white it has become grey, and this furnace now produces pig iron fit for the most

delicate castings, and quite equal to the English pig iron. When this iron is run into pigs the grain is large, of a leaden composition, and very brilliant. The grain of these pigs becomes much closer when it is run into thinner pieces, or moulded at the second fusion; in this case it is extremely soft under the shears.

"The Torteron furnace has been working eight-and-twenty months; the progress is very regular, and the charges succeed one another at nearly equal intervals; on an average, from 42 to 48 charges are made in the twenty-four hours; two sorts of ore are used in it; one called cold mine is the true iron ore of Berry; it is composed of small round grains of a brown colour, or with a slight ochrous tinge. The second sort, called hot mine, is very argillaceous; it is composed of grains scattered among fine and tenacious clay.

"In this furnace is used a mixture of charcoal (principally of oak) and coke, bought in the mines of St. Etienne.

"I have not the data necessary for determining with accuracy the alteration in the consumption of fuel, produced by the use of hot air in the blast furnace at Torteron; but the results obtained in two furnaces, situated near each other (Torteron and La Guerche in Cher), belonging to the same company, and carried on under nearly similar circumstances, are exhibited in the following tables, for which I am indebted to M. Boignes, who had the kindness to lend me the returns of the establishment."

Referring to these tables, M. Dufrenoy makes the following observations:—

"From these tables it appears, that the consumption for one ton of pig iron, or 1000 kilog. is,

	La Guerche.	Torteron.
Charcoal	833 kil.	828 kil.
Coke	413 ,,	443 ,,
Mine	2437 ,,	2802 ,,
Limestone	558 ,,	949 ,,
Coal for the steam engine	2,79 hect.	2,71 hect.
,, Heating apparatus	,,	415

"The comparison of these figures is not favourable to the use of hot air; but the yield of these furnaces cannot be exactly compared, on account of the difference that exists between the richness of the materials that are used; the mine melted in the furnace at La Guerche yields 41 per cent., whilst that melted at Torteron yields but 35. The quantity of limestone added to the mine at Torteron is nearly double what is used at La Guerche; notwithstanding these two unfavourable circumstances, the daily produce of the Torteron furnace surpasses that at La Guerche. Thus, if the proportion between the quantity of materials and the fuel were compared, instead of the quantity of fuel consumed and the pigs produced, the Torteron furnace would appear to be more economically carried on than that at La Guerche. In fact, at La Guerche, 1000 kilog. of mixed mine and limestone require 419 kilog. of fuel, whilst at Torteron for 1000 kilog. of the same mixture only 339 kilog. of coal is consumed.

"Thus the use of hot air is productive of a considerable saving at Torteron; and has also an advantage, not less important in its influence upon the quality of the pig iron, which has now become fit for foundry purposes; this circumstance has given it a value, which exceeds by nearly one-fourth the price of pig iron produced by means of cold blast."

We have the following notice of some other trials made in France, one of them being under the direction of Mr. Philip Taylor, from whose well-known abilities as an engineer, the most skilful arrangements were to be expected in the adoption of this principle:—

"Since last September, one of the three furnaces which compose the works of La Voulte, has been blown with hot air; the apparatus, which was constructed by Mr. Philip Taylor, civil engineer, consists of a horizontal pipe 0m, 57 exterior diameter, and 48 metres in length, having branches which point to each tuyere; this pipe, which is placed upon rollers to prevent the inconvenience which might result from dilitation, traverses the heating furnaces erected near the tuyeres. The position of the furnaces, which are built at a distance of only a few feet from an almost perpendicular declivity, opposed a serious obstacle to placing the apparatus. Mr. Taylor surmounted this difficulty by constructing an arch, which is supported both by the hill, and by the back wall of the furnace. The surface exposed to the action of the heat is 177,795 square meters; the quantity of blast thrown into each tuyere is 500 cubic feet per minute.

"Previous to the introduction of hot air, seventy-two charges were put into the furnace of La Voulte every twenty-four hours. Each charge consisted of—

	Kil.		Kil.
Mine	230	making in the twenty-four hours	16,560
Coke	200	,, ,,	14,400
Flux	60	,, ,,	4,320

"The mean produce, corresponding with these charges, was 7000 kil. of pig iron.

"As soon as the hot air was applied, the charges sunk more slowly; on the second day, 20 kilog. of mineral were added to every charge: the furnace worked well, and on the second day 40 kilog. more were added to each charge; this second addition of mineral hastened the descent of the charges, which were carried to seventy-six. The cinders were very thin, and bore all the appearance of good work, and the pig iron was crystallized and of a dark grey. During the two following days, 40 kilog. more were added to the charge. Mr. Taylor, who directed these trials, finding that the pig iron produced was still too grey for puddling, made another addition of 20 kilog. of mineral.

"On the eighth day seventy-six charges were thrown into the furnace, each consisting of—

Mine	350	making altogether 26,600 kil.
Coke	200	,, 15,200 ,,
Flux	60	,, 4,560 ,,

"The produce of pig iron amounted 11,000 kilog. of a mottled quality.

"Subsequently the number of charges was carried to eighty-four in the twenty-four hours, and the produce raised to 14,000 kilog.

"The fuel used for heating the air was 0,25 of raw coal to a ton of pigs.

"According to the report of the experiments made by Mr. Taylor at the establishment of La Voulte, the result was, that owing to the introduction of hot air, the consumption of coke necessary to produce 1000 kilog. of pig iron was reduced from 2057 kilog. to 1210, including the coal necessary for the heating apparatus, and reckoning this coal to have been transformed into coke.

"The La Voulte works exhibit, under the same roof, a furnace blown by hot air, and two furnaces blown by cold air, which are exactly alike in all their other circumstances; the results which have been pointed out may therefore be ascertained at any moment.

"At Riouperoux, in the department of Isere, M. Gueymard obtained similar results. The furnace, not long since, consumed 1610 kilog. of charcoal to the ton of pig iron. Since it has been blown by hot air (carried to 130 R.), it only consumes 1270 kilog. of coal, not reckoning the anthracite, or stone coal, which is used to heat the air, (Ann. des Mines, iv. 508): this result is the more important, as being the first example of hot air applied to a furnace fed by charcoal; it answers satisfactorily the doubts of those persons, who apprehended that the process could not be advantageously employed with this species of fuel."

M. Dufrenoy remarks at considerable length on the peculiarities of the coal used in our iron-works, on the quality of the iron obtained by the two processes, and the probable causes of the augmentation of heat, by the use of hot air. We pass over these observations, to extract the following summary, in which he gives the condensed result of his observations:—

"The details into which I have entered, concerning the principal works heated by hot air, may have obscured the chief circumstances of this process. I have therefore thought that it might be useful briefly to recapitulate them.

"I. In all the works, with one or two exceptions only, a great increase of the produce, a great saving in the consumption of fuel and limestone (as well as in the articles of labour and general charges), have resulted from the adoption of the hot-air system.

"II. These advantages have taken place in proportion to the degree of heat, to which the air has been raised.

"III. The quantity of cast iron produced has generally been greatly increased.

"IV. The total quantity of fuel consumed in the blast furnaces appears to be much the same, whether they are blown by hot or cold air. At the Clyde works, 18 tons of coke per diem were formerly used to obtain 6 tons of pigs; 18 tons of coal are now consumed, and 9 tons of pigs are produced.

"V. The pigs produced in hot-air furnaces are generally gray, and fit for castings: the process, however, is also successful in those works, of which either the whole or a part of the pigs are converted into bar iron (Condor Park, Tyne-works, Wednesbury, &c.); it being only necessary to modify the proportions of coal and minerals.

"VI. In several works, the combustion requires a much smaller quantity of hot air, than it formerly required of cold; at the Clyde-works, for instance, the same blowing engine which scarcely sufficed for three furnaces, now blows four. The saving of the moving power is not in proportion to the diminution of the quantity of blast, because a certain degree of force is necessary to overcome the friction of the air in the apparatus, and the resistance which results from its expansion. This last inconvenience is remedied by enlarging the opening of the nozzles; their diameter having generally been carried to from 3½ to 3 inches. The enlargement of the nozzles also diminishes the velocity of the current of air which is introduced into the furnace.

"VII. When no diminution in the quantity of blast (as at Torteron) results from the use of hot air, it is necessary to increase the power of the engines which work the blowing machine.

"VIII. The substitution of hot for cold air, in the fusion of iron mine, occasions an almost immediate change in the quality of the pigs, which become more carbonated. The charges descend slower; their descent is accelerated by augmenting the proportion of mineral.

"IX. The apparatus formed by the junction of a pipe of large diameter which receives the air, and of small pipes in which the air is heated and expands, appears to me preferable to an apparatus composed of a series of large pipes; the former requires less room, is less expensive, and consumes less fuel, than the latter; besides which, in the apparatus formed of large pipes, the temperature of the air is not uniform throughout every part, and a current of cooler air is almost always formed in the centre of the pipes.

"X. In order to diminish, as much as possible, the rapidity of the air submitted to the action of the heat, and to avoid the resistance resulting from its expansion, it is requisite that the area of the small pipes be greater than that of the large pipe, which receives the air from the blowing engine.

"XI. The interior capacity of these small pipes should be greater than the volume of blast, which is constantly cast into the furnace; by this arrangement, the air remains a certain time in the apparatus, and then acquires an elevated temperature.

"XII. This makes it appear, that the apparatus placed above the tunnel head is the least advantageous for furnaces using raw coal, as they cannot be of such dimensions as to admit of the air remaining within them any length of time. In order to remedy this inconvenience, it is necessary to pass the air again through the heating stoves, placed near the tuyeres.

"XIII. Coals which would produce a large per centage of coke, dry, and anthracitous, may be used in their raw state, even in cold-air furnaces.

"XIV. Coals which contain a tolerably large proportion of volatile matter (30 to 35 per cent.), but which are not adhesive, and do not change their shape in combustion, may be used without coking, in furnaces of which the blast is heated above 300 degrees cent.

"XV. Lastly, it appears necessary to coke bituminous coal (like that of Newcastle), even when the hot-air process is used, in order to render it fit for the fusion of iron ore."

The foregoing notice will be sufficient to show the value and importance of the work before us, which we have much pleasure in recommending to all who are interested in the iron manufacture of this country, as the most complete and useful summary that has appeared, of the past progress and present state of the hot-air blast. Its value would, in our opinion, have been increased, had the French weights and measures been reduced to English, instead of allowing them to retain their original form; a circumstance which cannot be otherwise than inconvenient to the reader. We may observe, that the work is well translated, evidently by a person conversant with the iron manufacture; and several notes are given by the Translator, either rectifying slight errors into which M. Dufrenoy has in some cases fallen, or adding more recent information on the subject. Very useful illustrations are furnished by ten plates of apparatus, &c., and numerous tables of data and results are given.

We must confess it would have been more pleasing to us to have seen a similar work issue direct from the English press; and we cannot but feel that it is humiliating to owe to a foreigner, the first detailed account of the progress of an invention which had its birth in this country, and which has here been attended with such signal success. While, however, we lament this circumstance as a blot, on what we may term the mining literature of this country, we must acknowledge our obligation to the Translator of this work, for having to a certain extent supplied the deficiency, which, to whatever cause it may be attributed, had certainly been allowed to exist.

Scientific Memoirs, selected from the Transactions of Foreign Academies of Science, and Learned Societies, and from Foreign Journals. Edited by RICHARD TAYLOR, F.S.A., F.L.S., F.G.S., &c. &c. Vol. I., Parts 1 and 2. Longman and Co. London, 1836.

The rapid progress of scientific research at the present time, renders indispensable a corresponding activity in the publication of the views and discoveries of men of science. As regards our own country, this object is fully effected by the frequent appearance of the Transactions of Scientific Societies, and by the ably-conducted journals and other publications devoted to the same object.

It will, however, we believe, be generally admitted, that if any desideratum still remains, it is that of rendering more accessible and more generally known, the proceedings of foreign philosophers, as detailed in the principal scientific journals of the continent. This desideratum, then, the present work is intended to supply; and from the specimen before us, we have little doubt that it will effect the object in view.

The papers it contains are translated from foreign works of acknowledged value, chiefly the Transactions of the Scientific Societies of France and Germany, and embrace a variety of subjects of deep interest in the more abstruse branches of scientific knowledge. We can hardly, perhaps, give a better idea of the work, than by enumerating some of the papers contained in the first number. It commences with two "Memoirs, on the free Transmission of radiant Heat, through different solid and liquid Bodies," by M. Melloni. These are followed by "Experiments on the Circular Polarisation of Light," by Professor Dove, of Berlin; and the "Description of an Apparatus for exhibiting this and other analagous phenomena," also by Professor Dove. A "Memoir on Colours generally, and a new Chromatic Scale," by M. Leopold Nobili. "Memoir on the Mathematical Theory of Heat," by S. D. Poisson. "Researches on the Elasticity of Bodies, which assume regular Crystalline Forms," by Felix Savart. "Experiments on the essential Oil of the *Spiræa Ulmaria*, or Meadow-sweet," by Dr. Lowig. The second number does not contain quite so much variety, but the papers are equally valuable, a large space being devoted to the departments of natural history and physiology.

We may further observe, that the work is well translated, the foreign scientific terms and modes of expression being happily and correctly rendered into our own language. It is also illustrated by several well-executed copper-plate engravings, descriptive of the phenomena treated of in the various papers it contains.

We would suggest, in a work of this kind, the reduction of all foreign scales to an English standard, as saving much unnecessary trouble to the reader; and we are inclined to think, that it would occasionally be advantageous to give literal translations *of the most important parts of papers only*, and to connect these portions by careful abstracts of the intervening parts. Considerable judgment would of course be necessary in adopting a plan of this kind; but should it be found practicable, the space thus gained might be made the means of giving greater interest and variety to the work, than would be possible in its present form, owing to the great length of many of the papers which are introduced. A work embracing the whole range of science, will of course, occasionally only, contain matter suited for extract in our columns; and the two parts of "Scientific Memoirs," now before us, include no papers coming strictly within our province. From M. Poisson's "Memoir on the Mathematical Theory of Heat," we may, however, extract the following passages, relative to the internal temperature of the globe:—

"*On the Motion of Heat in the Interior and upon the Surface of the Earth.*—It is shown that the formulæ of the preceding chapter, although relating to a homogeneous sphere, the surface of which is every where in the same state, may notwithstanding serve to determine the temperatures of the points of the earth at a distance from the surface, which is very small with regard to its radius, but which extends, however, all accessible depths. These formulæ contain two constants, depending on the nature of the soil, the numerical values of which may be determined in every point of the globe from the temperatures observed at different known depths.

"Observation in harmony with theory shows that the diurnal inequalities of the temperature of the earth disappear at very small depths, and the annual inequalities at greater depths, in such a manner that at a distance from the surface of about twenty metres, and beyond, those two kinds of inequalities are entirely insensible. In this chapter are given tables of the temperatures, indicated by the thermometer, of the caves of the Observatory,* at the depth of twenty-eight metres. The mean of 352 observations, made from 1817 to the end of 1834, is 11°·834.

"The increase of the mean temperature of the earth, in proportion as we descend below the surface, has long been established as a fact in all deep places, at different latitudes, and at different elevations of the soil above the level of the sea. The most adequate means to determine it is by *sounding* and boring. The results, still very few, which have hitherto been obtained, are given. At Paris, this increase appears to be one degree for about thirty-eight metres of increase in depth.

"As to the cause of this phenomenon, the difficulties are stated which the explanation of Fourier presents, founded upon the original heat of the globe, still sensible at the present time near the surface; the new explanation alluded to at the beginning of this article is then proposed. The following reflections extracted from the work tend to prove that the solidification of the earth must have commenced by central strata, and that before reaching the surface the cooling of the globe must have been incomparably more rapid.

"'The nearly spherical form of the earth and planets, and their flattening at the poles of rotation, evidently show that these bodies were originally in a fluid or perhaps in an aëriform state. Beginning from this initial state, the earth could not, wholly or partly, become solid, except by a loss of heat arising from its temperature exceeding that of the medium in which it was placed. But it is not demonstrated that the solidification of the earth could have commenced at the surface and been propagated towards the centre, as the state of the globe still fluid in the greatest part of the interior would lead us to suppose; the contrary appears to me more probable. For the extreme parts, or those nearer to the surface, being the first cooled, must have descended to the interior, and been replaced by internal portions, which had ascended to cool at the surface and to descend again in their turn. This double current must have maintained an equality of temperature in the mass, or at least must have prevented the inequality from becoming in any way so great as in a solid body, which cools from the surface; and we may add, that this mixture of the parts of the fluid, and the equalization of their temperatures, must have been favoured by the oscillations of the whole mass, which must have taken place until the globe attained a permanent figure and rotation. On the other hand, the excessively great pressure sustained by the central strata may have determined their solidification long before that of those nearer the surface; that is to say, the first may have become solid by the effect of this extreme pressure at a temperature equal or even superior to that of the strata more distant from the centre, and consequently subjected to a much less degree of pressure. Experiment has shown, for example, that water at the ordinary temperature, being submitted to a pressure of 1000 atmospheres, experiences a condensation of about one-twentieth of its primitive volume. Now let us conceive a column of water whose height is equal to one radius of the globe, and let us reduce its weight to half of that which we observe at the surface of the earth, in order to render it equal to the mean gravity which would exist along each radius of the earth upon the hypothesis of its homogeneity; the inferior strata of this liquid column would experience a pressure of more than three millions of atmosphere, or equal to more than three thousand times the pressure which would reduce water to nineteen-twentieths of its volume; but without knowing the law of the compression of this liquid, and although we do not know in what manner this law may depend on the temperature, we may believe, notwithstanding, that so enormous a pressure would reduce the inferior strata of the mass of water to the solid state, even when the temperature is very high. It seems, therefore, more natural to conceive that the solidification of the earth began at the centre, and was successively propagated towards the surface: at a certain temperature, which might be extremely high, the strata nearer the centre became at first solid, by reason of the excessive pressure which they experienced; the succeeding strata were then solidified at a lower temperature, and under a less degree of pressure, and thus in progressive succession to the surface.'

"If the increase observed in the temperature of the earth near its surface is due to its original heat, it follows that at the present epoch at Paris this heat raises the temperature of the surface itself only by the fortieth part of a degree. Not knowing the radiating power of the substance of the globe, we cannot estimate the quantity of this initial heat which traverses in a given time from within to without an extent, also given of the surface; but such would be its slowness in dissipating into space, that more than one thousand million of centuries must elapse to reduce the small increase of the fortieth of a degree to one half.

"With regard to periodical inequalities, the relation which exists between each inequality at a given depth, and the inequality corresponding to the exterior temperature is determined. Relations of this nature, for the knowledge of which we are indebted to M. Fourier, take place between the interior inequalities and those of the surface of the ground; these relations leave unknown the ratios of these latter inequalities to those of the outside which are the immediate data of the question.

"The interior temperature to which the earth is subjected arises from three different sources, namely, from sidereal heat, from atmospherical heat, acting either by radiation or by contact, and from solar heat. These three sources of heat are successively examined. With regard to the first it is observed, that it is not at all probable that radiant heat emanating from the stars has the same intensity in all directions when it arrives at the earth. The experiments are indicated which it would be necessary to make in order to ascertain whether it really varies in the different regions of the sky. M. Melloni intends immediately to apply himself to these experiments, employing in them an extremely sensible instrument, of which he has made use in his researches on heat; a circumstance which cannot fail to lead to the solution of this important question of celestial physics.

"Before considering the influence of atmospherical heat, I have formed a complete expression for the temperature, marked every instant by a thermometer suspended in the air, at any height above the surface of the earth, exposed in the shade or in the direct rays of the sun. Although the greatest part of the quantities which this formula contains are unknown to us, many general consequences may however be deduced from it, which accord with experiment; it hence follows, that to determine the proper temperature of the air, it is necessary to employ the simultaneous observation of three thermometers, the surfaces of which are in a different state, and not two thermometers only, as is generally said. This formula also furnishes the means of comparing the temperatures indicated by different thermometers in relation to their radiating powers, and to their property of absorbing the rays of the sun.

"The mean of the annual temperatures, marked by a thermometer exposed in the open air and in the shade, forms the *climateric* temperature. It varies with the elevation of places above the level of the sea, and with the longitude and latitude, according to unknown laws. At Paris it is 10°·822, as M. Bouvard has concluded, after twenty-nine years of observations. There will be found in this chapter a table of the mean temperatures for the twelve months of each of those years, which that gentleman has been pleased to communicate to us, and which had not before been published. It appears that in every point of the earth this climateric temperature differs very little from the mean temperature of the surface of the soil, as is shown by several examples. Notwithstanding, the variable temperature of this surface, and that which is marked at the same instant by a thermometer as little elevated above the surface as may be, are often very different from each other; it hence follows, that in a year the excess of the highest above the lowest temperature of the soil is at Paris nearly 24°, as will be seen in the course of this chapter; and only about 17° for the thermometer suspended in the air and in the shade.

"We now determine the part of exterior temperature which results from the atmospherical heat combined with sidereal heat. The necessary data for calculating its numerical value, *à priori*, being unknown to us, we shew how this value, for every point of the globe, may be deduced from the mean temperature of its surface. At Paris this exterior temperature is 13°. Although we cannot determine separately the portion of this temperature of the earth which arises from the atmospherical heat, there is reason to think that it is

* The Observatory of Paris.

also negative, so that the other portion arising from sidereal heat must be less than 13° below zero. If we suppose that radiant heat emanating from the stars falls into the same quantity on all points of the globe, this temperature, higher than 13°, will be that of space at the place where the earth is at this time. Without being able to assign the degree of heat of space, we may however admit, that its temperature differs little from zero, instead of being, as had been asserted, below the temperature of the coldest regions in the globe, and even of the freezing point of mercury. As to the central temperature of the whole mass of the earth, even supposing its original heat to be entirely dissipated, and that it is no longer equal to the present temperature of space, we have no means of obtaining a knowledge of it.

"According to a theorem of Lambert, the whole amount of solar heat which falls upon the earth is the same during different seasons, notwithstanding the inequality of their lengths, which is found to be compensated by that of the distances from the sun to the earth. This quantity of heat varies in the inverse ratio of the parameter of the ellipse described by the earth; it also varies with the obliquity of the elliptic; but it does not appear that these variations can ever produce any considerable effect on the heat of the globe. The quantities of solar heat which fall in equal times upon the two hemispheres are nearly equal; but on account of the different states of their surfaces, those quantities are absorbed in different proportions; and the power of absorbing the rays of the sun increasing in a greater ratio than the radiating power, which is greater for dry land than for the sea, we conclude that the mean temperature of our hemisphere, where dry land is in a greater proportion, must be greater than that of the southern hemisphere; which agrees with observation.

"The solar heat, which reaches each point of the globe, varies at different hours of the day; it is null when the sun is beneath the horizon; during the year it varies also with its declination; and the expression changes its form as the latitude of the point under consideration is greater or less than the complement of the obliquity of the elliptic. I have therefore considered the part of the exterior temperature which arises from this source of heat as a discontinuous function of the horary angle, and of the longitude of the sun, to which I have applied the formulæ of the preceding chapters, in order to convert it into series of sines and cosines of the multiples of these two angles. By this means I have obtained the complete expressions of the diurnal and annual inequalities of the temperature of the earth which arise from its double motion. These formulæ show, that at the equator the annual inequalities are much less than elsewhere; a circumstance which furnishes the explanation of a fact observed by M. Boussingault in his journey to the Cordilleras, and upon which he had relied in order to determine with great facility the climateric temperatures of the places which he visited. The same formulæ agree also, in a remarkable manner, with the temperatures which M. Arago has observed at Paris during many years, and at depths varying from two to eight metres (from 6·56 to 26·24 English feet)."

We may also extract the following curious views, from a paper on "The Kingdoms of Nature, their Life and Affinity," by Dr. C. G. Carus:—

"The great elementary masses of the earth are formed and governed by many powers, among which we may distinguish those which relate to the individual preservation of the planet, from those which originate in other heavenly bodies. Of the former the most remarkable is Gravitation, which manifests itself as the immediate principle of internal unity, the *sensible* tendency of all parts of the earth to a common centre, and therefore to an *ideal* unity, since, according to Euclid, no point can be represented materially. But another effect presenting itself in the *visible* relation of the earth to other heavenly bodies, is that which we perceive under the form of light. These two powers, when united, produce other phenomena; for instance, heat, which results from the opposition between the rays of light and the direction of gravity: wherefore we observe the heat of the earth to be more intense, the more the heated body is found to be in a straight line between the illuminating and the illuminated object, that is, between the centre of the sun and that of the earth. To these also belongs the phenomenon called magnetism, as the effect of the gravitation of the earth, and its position with respect to the other planets, *i. e.* the direction of its axis. In heat the predominant principle is light; whereas the predominant principle in magnetism is gravitation. To these we find new powers still added, among which the mechanical and the chemical appear to be allied to gravitation and magnetism (for the laws of mechanics are essentially connected with those of gravitation, as the chemical laws include the compositions and decompositions, the attractions and repulsions of ponderable bodies), while electricity and galvanism, on the contrary, being more connected with light and heat, are found less inherent in terrestrial substances. A body which is an electric or galvanic conductor can be conceived to exist without electric or galvanic power; whereas no earthly substance can be imagined without the chemical effects proper to its composition, and the mechanical operations proper to its form. It is, moreover, worthy of remark, how all this series of powers, which constitute in their totality the life of the planet, is found also in its single parts constantly and in the most various forms; for we find in every object a proportionate gravitation of the mass towards its centre. This fact explains the mutual attraction of two bodies floating in a fluid, the formation of a drop of water, and the nature of the globular form in general as one in which all the radii, or the relations of the periphery to its centre, are equal. It explains also the mutual illumination of single terrestrial bodies; the production of heat as the result of the collision of different bodies; the manifestation of electricity, not only in the stormy atmosphere, but also in resin and glass; and the manifestation of terrestrial magnetism in the smallest bar of iron. These objects, for the complete examination of their endless variety and eternal regularity, require a full development of the laws of chemistry and natural philosophy—a development which would exceed the limits of this treatise as much as it does the powers of the author, and which, in its full and scientific comprehensiveness, is still a desideratum.

"But our purpose demands a particular examination of the relation of water to the other atmospherical and terrestrial substances, more particularly because it forms, as we shall show, the most essential link between organised and unorganised bodies, or rather the constant source from which the former arise. Water, considered in its *threefold* form, as solid, fluid, and gaseous, presents a true middle and connecting member between the planet and its atmosphere. It may be considered as the *indifference* of both—on which fact depends its decomposition into a combustible element (hydrogen), and an element promoting combustion (oxygen), nay, it is in its purity *really* indifferent in respect to the other terrestrial as well as to atmospherical substances. But the manifold in nature, however far back in point of time we trace its origin, will be found constantly issuing out of the simple and indifferent; and on this very account water, as far as it appears an *indifference*, becomes the germ and source of an infinity of other forms; indeed it is a question whether we are not already justified in supposing, and whether further inquiries will not establish the fact, that both the planet and its atmosphere are but different developments of one and the same original fluid. Several of the older chemists (Leidenfrost, Wallerius, Markgraff) have attempted to show, that even now, during certain chemical processes, particles of water are changed into earth; and though Lavoisier has sufficiently refuted that opinion, he has not demonstrated the impossibility of the decomposition of an *original* fluid into water, air, and earth. That water is of the utmost importance in the general formation of the earth, has been proved beyond doubt by the excellent experiments of the immortal Werner; and we are justified in continuing still to believe in its importance to the preservation and life of the planet, when we take into consideration both its quantity and its continual motion. In regard to its quantity, we find that of the sum total of the surface of the globe (9,000,000 square miles), the water occupies nearly 6,500,000, and the land only 2,500,000. The water is so deep also, that several points of the sea are unfathomable, although latterly it has been fathomed to a depth amounting to 4600 feet. The motion of the water, on the other hand, depends partly on gravitation, as in the running of rivers and streams; partly on the attraction of other planets (viz. the sun and moon), as in its ebbing and flowing in the tides, and in its ascending and descending between the earth and sky in the form of vapour, dew, rain, snow, &c. Comparing animal with planetary life, we are therefore led to conclude, that as a homogeneous fluid, in continual circulation, the blood is the source in which all forms and reproductions of the organism originate, so is water one of the members most important to the life of the earth. This internal life of the fluid becomes indeed more evident when we consider the individual formations of the solid to which it gives birth. The most striking illustration of this is the process of crystallization, which exhibits a near approach of the inorganic to the organic life; for we cannot deny, even to the crystal, a certain inward peculiar life at the moment of its formation. The only difference between an organic body and a crystal is, that the life of the latter, the principle of action and re-action, terminates as soon as its formation is accomplished. One might be tempted to say that the crystal lives only to form itself; for as soon as it is formed it dies; while true organisms, on the contrary, form themselves only in order to live, and it is only when they are perfectly formed that their life is truly and properly evident. But the formation of the crystals, as a process nearly allied to organic life, is not the only phenomenon remarkable in them. The very forms of the crystal are, in their approximation to the form of the organised being, well worthy of a closer attention. We find in all earthy, as well as in many metallic or combustible fossils, the purely geometrical form of the crystal, which, in proportion as it is more compact, and presents a more limited coincidence of surface with other forms, approaches more nearly the spherical form, as that which is perfectly compact, thoroughly symmetrical, and therefore fundamentally organic. The icosahedron, for instance, approaches the spherical form more nearly than the octahedron does; it is also important to observe that the most precious crystals, and especially the diamond (which being pure carbon, is therefore, from its composition, most closely allied to the organised bodies), are those wherein we observe the most compact crystallization, at least that which approaches most nearly to the sphere, and is therefore in no wise columnar; wherefore the diamond, particularly on account of its power of refraction, has a closer resemblance to a solid drop of water."

The nature and merits of Mr. Taylor's "Scientific Memoirs," will, no doubt, be sufficiently apparent from the extracts here given, and the observations by which they were preceded; and we notice, with pleasure, the appearance of a work, which promises to be of so much benefit to science.

Introduction to the Study of Geology, designed to facilitate a general acquaintance with the principal facts and theoretical deductions of that Science, more particularly as applied to the Internal Structure of Great Britain. By FREDERICK BURR. Whitaker and Co., and J. and C. Walker. London, 1836.

This treatise, as its title-page imports, is "designed to facilitate a general acquaintance with the principal facts and theoretical deductions of the science of geology, more particularly as applied to the internal structure of Great Britain." How far the author has succeeded in his work will be best judged by the extracts we shall make, while the general circulation which we naturally assume the work itself will acquire, renders the less necessary any remark on our part, other than that of commendation.

It has been frequently observed with much justice, that we can boast of few works directed to the sciences of geology or mineralogy, information of this nature being, in many instances, only to be acquired through the medium of Continental works. It is true, that we have of late made considerable advances, to which the proceedings of the Geological Society (although somewhat contracted) and the British Association of Science, have contributed; and amongst other works of science issued from the press, that of Dr. Buckland, on Geology and Mineralogy, a review of which appeared in our late numbers, stands pre-eminent in the general absence of works treating on these important and interesting sciences. We, therefore, hail with pleasure, the publication of a treatise like the present, more especially as from the familiar style in which the subject is treated, it is well calculated to lead those to labour in the field who have hitherto considered the science too abstruse, or attended with a difficulty of acquirement, which too frequently deters those who are desirous of acquiring information from collecting it from the original sources. Divested, as this introduction is, of technical phrases, and written in a comprehensive style, we cannot doubt but that it will effect the desired object, of facilitating the acquisition of this branch of knowledge, not only in communicating facts associated with geology and mineralogy, but, illustrated as it is, by the very able work of Messrs. Walker, we refer to their Geological and Mineralogical Map, noticed in a late number. It is works of this nature which so strongly tend to the encouragement of science, and to the promulgation of knowledge, while they are alike the means of developing much valuable information, and which, but for attention being directed to the subject, might remain for ages disregarded and unknown. Speaking of subterranean heat, "closely resembling, if not identical, with volcanic action," the author cites one or two facts, as confirmatory of the opinion he adduces. He observes,—

"When dykes, or masses of *basalt*, come in contact with beds of coal (a circumstance which often happens in the north of England) the coal in its vicinity is generally found to be converted into *coke* or *cinder*, clearly proving that when the basalt assumed its present position, it must have been in an intensely heated state, and as it now occurs, *completely filling up irregular rents or chasms* in the coal strata, there can be no doubt that when ejected from below, it was in a state of *actual fusion*. Were further proof needed that such is the origin of basalt, it would be furnished by the fact that this rock often exactly resembles the more compact *lavas* known to have issued from volcanic craters, this resemblance extending not merely to external texture and appearance, but to actual chemical composition."

The author then proceeds to give a sketch, briefly explanatory of those great revolutions which the earth appears to have undergone, and from which we make the following extract, which will give some idea of the manner in which the subject is treated, our space, and, indeed, the circumscribed limits of the work under notice, rendering it indispensable that our notice should be brief. Mr. Burr observes,—

"It is evident, from what has been before stated, that *oceanic* agency on the one hand, and *volcanic* agency on the other, have been extensively employed in giving the earth its present form and structure. The volcanic agency here alluded to must not, however, be confounded with that which is *now* in action; although perhaps the same in kind, it was more intense in power, and infinitely more extensive in operation. It would appear indeed highly probable that the original condition of the globe was no other than a fused mass of volcanic matter, destitute both of life and organization, and evidently in a state to preclude the possibility of the existence of either, till it had undergone great and long-continued modification. Subsequently to this remote period, 'dark illimitable ocean, without bound,' appears to have prevailed over the face of the globe, in the midst of which at intervals abrupt insular masses and mountain chains, were upheaved by internal convulsions of the heated mass. The consequent agitation of the ocean, and the gradual action of atmospheric agency, wearing away these elevated masses, appear to have given rise to the earlier *sedimentary deposits*, or those resting immediately on the unstratified rocks, themselves portions of original volcanic matter. Similar processes appear to have continued through a long succession of ages; internal convulsions, regulated probably by unknown causes, elevating from time to time new and more extended tracts, which would now consist partly of volcanic or *unstratified*, and partly of sedimentary or *stratified* masses. In this manner fresh lines of coast would be continually presented to the action of the agitated waters, and the rivers which would then become necessary to drain these tracts of dry land, would afford ample materials for new sedimentary deposits, some of which would still be oceanic; while as the earth slowly approximated towards its present configuration, others would originate, as now, in lakes and estuaries. Thus, in process of time, the original mountain peaks and chains would become mantled around and partially concealed by their present thick covering of stratified deposits."

We have on several occasions given insertion to the communications of correspondents, on the ideas furnished by geological researches relative to the Creation of the World, and here, therefore, we are induced to extract the author's views and reading of the sacred volume:—

"Four points of the physical history of the earth are involved in the Mosaic narrative—the successive steps of creation—the time employed in these operations—the age of the world, *since* that period—the catastrophe of the deluge.

"On three of these points, the agreement of natural records with those of revelation is decided and unequivocal. The successive steps of creation, both as regards the framework of the globe itself, and the development of organic existence upon it—these, whether deduced from the language of nature or of revelation, are the same. The age of the world subsequently to assuming its present condition, appears from the inspired writings to be about six thousand years, and the voice of natural records (for the earth bears marks of her own antiquity) speaks the same language. The physical proofs of diluvial catastrophes, have already been noticed at sufficient length to show their strict coincidence with the Mosaic narrative.

"One point then, and one only, remains open for discussion: we are told by Moses, that the earth was *created* (or brought into its present state) *in six days*, while geological phenomena, in the most impressive and unequivocal language, indicate a lapse of time for which no period can be fixed, but in the contemplation of which, as in that of infinite space, the mind is overwhelmed in unappreciable vastness. Hence then arises the question, and if calmly and dispassionately viewed, it is perhaps a simple one—Are the '*days*' of Moses, literally to be understood as days of twenty-four hours?

"A discussion on this subject would here be out of place, yet we would observe, that both the natural day and the week of seven days, are merely periods adapted to the constitution and physical wants of *man*, and therefore *previous to his existence* were unnecessary, and could have answered no end. Is it not, therefore, reasonable to suppose that the *days of creation* were merely intended as *types* of those afterwards established, without any reference to their *actual duration?*

"When we consider that the sole office of these periods, denominated '*days*,' was to estimate the operations of a Being, 'in whose sight a thousand years are but as yesterday,' may we not, without violation of Scripture, look upon them as those periods of vast and indefinite duration, which are pointed out to us by geological phenomena; if this point be conceded, the discrepancy long supposed to exist between geological science and revelation is at once annihilated, and, on the contrary, the strictest harmony will be found to prevail."

A general description of the most important rocks, especially those occurring in Great Britain, enables our author briefly to notice the stratified and unstratified rocks, describing their peculiar formation, their properties, and the localities where they are principally developed;—of these formations that of the coal is an interesting and pleasing illustration. The following extract describes its general position:—

"The most southern of our coal-fields occurs in Somersetshire, and is remarkable from the inclined strata of the coal and subjacent rocks, being overlaid by horizontal deposits belonging to the new red sandstone and oolite formations, which have been successively sunk through, in order to reach the coal. The coal-field of the Forest of Dean, in Gloucestershire, is of smaller extent, and the iron manufacture is here carried on. The extensive coal district of South Wales and Monmouthshire is one of immense area, and of great importance, both from its present enormous produce of coal and iron, and from the large portion of it which, being yet unwrought, may be considered in the nature of a reserve for future ages.

"The coal district of Staffordshire is one of vast importance; the great thickness of one of its seams has already been noticed, and the manufacture of iron is here carried on to an immense extent, especially in the neighbourhood of Dudley, Wednesbury, Bilston, and Wolverhampton. There are several coal-fields of great local value in the neighbouring counties of Warwickshire, Leicestershire, and Shropshire; and in the coal district adjoining Broseley, and Wellington, in the latter county, a considerable quantity of iron is made. Further north is the great coal-field of North Wales, bordering on the estuary of the Dee, and a smaller one occurring in the Isle of Anglesea. The coal districts of Lancashire, Derbyshire, and Yorkshire, spread over a vast tract of country, and have given rise to the various manufactures so successfully carried on in these counties. The Whitehaven coal-field is extensively worked, and the coal district of Durham and Northumberland, independently of a vast local demand, supplies both the consumption of London, and of our eastern and southern coasts. The position and extent of these important tracts, to which England owes so much of her wealth and prosperity, can only be vaguely indicated by description, but will at once be clearly and distinctly recognised, by reference to a geological map of the country.

"In Scotland there are many coal-fields, some of them being of considerable extent: the most important is that in the neighbourhood of Glasgow, which has given rise to the iron-works, and other manufacturing establishments of that flourishing town and its vicinity. The coal formation of this country may be said to extend (though not continuously) in an east and west direction, from the Firth of Clyde to the Firth of Forth, occupying large portions of the following counties: Lanarkshire, Stirlingshire, Linlithgowshire, Fifeshire, Edinburgh, Haddington, and Peebles. It also occurs, but more sparingly, skirting a portion of the eastern coast of Scotland.

"Coal is abundantly distributed in Ireland, where there are four principal coal districts, the Connaught and Ulster, which produce bituminous coal, and those of Leinster and Munster, which produce only stone-coal, or the carbonaceous variety.

"It is difficult to ascertain the annual produce of the various coal districts of Great Britain, yet we may probably estimate that at the present time it does not fall short of the enormous sum of twenty million tons, while our produce of iron, chiefly from the same series of rocks, must amount to above seven hundred thousand tons. The immense importance of these internal sources of wealth, can require no comment.

"The coal formation is found in many parts of France, Spain, Belgium, Germany, and indeed most parts of the continent of Europe; it occurs also in Asia, where it has long been extensively worked by the Chinese. It is found in many parts of North and South America, and also in India and Australia."

Passing over the entire series of secondary rocks, we find the following observations on the primary clay slate, which we extract as appertaining to our mineral districts:—

"This rock considerably resembles some of the finer varieties of greywacke slate. It is composed of silex, alumine, and oxide of iron, with other substances in small proportion. Its texture, as the name implies, is slaty, and it generally separates into pieces of a rhomboidal form, having a silky appearance, parallel to the thin laminæ of which it is composed, but a dull earthy cross fracture. It is often unctuous to the touch, and of a greyish, bluish, or brownish colour, sometimes nearly black. This rock is widely distributed; it is found in the mining districts of Cornwall, in Scotland, in many parts of the continent, and America. Although occasionally used both as a building-stone and roofing-slate, the quality is much inferior to many other kinds of stone. This rock is, however, of great importance, from the mineral wealth which, in common with most others of the primary class, is often included in it. The great mining districts of Cornwall are principally situated in clay-slate, provincially termed '*killas*:' it there contains veins of tin and copper, of extraordinary richness and produce, and which have long constituted the principal wealth of the county. The clay-slate of Cornwall generally rests immediately upon granite, and it is chiefly at, or near the junction of the two rocks, that the principal mines are situated. This is the case with the great Consolidated Mines, the rich Tresavean Mine, the productive Carn Brea Mines, the well-known Dolcoath Mine, and many others. It may be observed that many of these mines are worked to a very great depth: the Consolidated Mines are about 300 fathoms, or 1800 feet below the surface, being deeper than any other mine in Great Britain. The value of the copper ore raised in Cornwall, amounts to nearly a million sterling, yearly; and the value of the tin and other metals, probably falls little short of a similar amount. Clay-slate is also metalliferous in Ireland, on the continent, and in America, when the *Valenciana*, formerly the richest of the Mexican silver mines, is partly situated in this formation."

Speaking of granite as connected with our mineral deposits, the author observes—

"The ores of a great number of metals are situated in granite; many of the most productive tin and copper veins in Cornwall being worked in, or immediately adjoining, this rock. Tin, however, is the metal most abundantly found in it, usually in veins, but often disseminated throughout the mass of the rock, which is the case at the celebrated Carclaze mine. Granite is also metalliferous in many other countries, although perhaps less so than some of the primary rocks previously described, which may be considered as forming, in all parts of the world, the principal depositaries of the metallic ores."

Some apposite remarks "On the study of Geology, and utility of Geological Maps and Sections, with a tabular statement of the Mineral Produce of Great Britain," conclude the treatise, which has afforded us much pleasure in its perusal, as it must instruction to those who consult its pages. We would observe, that although written to accompany the "Geological and Mineralogical Map," to which we have already referred, and to which it is a valuable adjunct; the "Introduction" will in itself amply repay the reader, and may, we hope, be considered as merely the precursor of others, which, if not of higher merit, may enter more minutely into geological facts and deductions. It is hardly necessary for us to observe, that the public are much indebted to Mr. F. Burr, who, in addition to the many articles which have appeared in the *Mining Review* and *Mining Journal*, which we should hope there was no occasion for us to recapitulate, has thus endeavoured, and we think successfully, to fill up a *hiatus* which existed, and thus formed the stepping-stone to works of a higher order, and claiming a more prominent position in the records of science.

London and Edinburgh Philosophical Magazine and Journal of Science for December, 1836.

The high character and established reputation of the "Philosophical Magazine," is such as to render any observation unnecessary on our part. Many excellent papers are contained in the present number, which is accompanied by a supplement, concluding the volume, and chiefly occu-

plied by reports of scientific societies. From the hasty glance we have had of this number, we may enumerate two or three papers which appeared to us to possess peculiar interest; these are, "On the Carboniferous Series of the United States of North America," by R. C. Taylor, Esq.; "On Meteoric Stones," by Professor Berzelius, and an anonymous, but able, paper on the "Art of Glass Painting." We must express our satisfaction at finding this beautiful, but long neglected art, again attracting attention, and the paper to which we have alluded affords much information as to the chemical processes by which many of the tints are obtained. We may also notice a paper by N. T. Wetherell, Esq., describing the fossils which have been discovered in cutting through the London clay, in the excavations for the London and Birmingham Railway, in the neighbourhood of Chalk-farm and Hampstead-road.

REMARKABLE ILLUSTRATION OF VOLCANIC ACTION,

EXHIBITED IN THE SLOW COOLING OF SILVER AFTER FUSION.

We have selected the following extract from a well-known work, the "Traité de Geognosie," by M. D'Aubuisson de Voisin, to form the first of a series of translations from foreign works of acknowledged merit, which we intend from time to time to present to our readers. The extract bears on one of the most interesting, but obscure, questions of theoretical geology, on which it seems likely to throw considerable light; while it also shows the importance of phenomena which may often pass unheeded by practical men, merely for want of knowing the ulterior views with which they may be connected, or which they are capable of affording to the man of science. Should these or any analogous appearances be observed by any of our readers, who may be engaged in the practical operations of metallurgy, we trust they will immediately be communicated to the public through the medium of our columns, which will ever be open to whatever is calculated to advance either the art of mining, or any of the various sciences with which it is so intimately connected.

ON THE SOLIDIFICATION OF SILVER IN FUSION.

THE RESULT OF THE EXPERIMENTS OF M. FOURNET, AS APPLIED TO HIS NEW THEORY OF VOLCANIC FORMATIONS.

By the experiments of Messrs. Lucas and Guy Lussac, it is found that silver in a state of fusion, and exposed to the atmosphere, absorbs oxygen, and on becoming solid, gives it out again. The quantity of this gas thus absorbed may amount to twenty-two times the volume of the mass of silver; and to its evolution is to be ascribed the apparent ebullition observed by assayers. Hitherto no attention has been paid to the remarkable circumstances attending this process, when the experiment is conducted on a somewhat larger scale.

Having had occasion frequently to refine, in small reverberatory furnaces, silver bars of forty to fifty pounds weight, I can warrant the following as correct results, when the silver is sufficiently fine, and the cooling gradual. The solidification commences at the edges and advances towards the centre, and the silver when passing from a fluid to a solid state, experiences a very slight agitation or ebullition, and then becomes motionless. Matters remain thus for a short time, to all appearances perfectly tranquil, when suddenly a part of the surface becomes irregularly perturbed, fissures appear in one or several lines, from which flow, in different directions, streams of very fluid silver, which increase the original agitation. The first stage does not yet clearly manifest the presence of gas, and seems to arise from some intestine motion of the particles in their tendency to group on entering the process of crystallization, and thus causing the rupture of the envelope, or external crust, and the ejection of some liquid portions.

After remaining some time tranquil, the metal presents a fresh appearance, precisely analogous to volcanic phenomena. As the crystallization continues, the oxygen gas is given out with violence at one or more points, carrying with it melted silver from the interior of the surface, producing a series of cones, generally surmounted by a small crater, vomiting out streams of the metal, which may be seen boiling violently within them.

These cones gradually increase in height by the accumulation of metal thrown up, and that which becomes consolidated on their sloping sides. The thin crust of metal on which they rest consequently experiences violent impulses, being alternately raised and depressed by such violent agitation, that were it not for the tenacity and elasticity of the metal, there would evidently arise dislocations, fissures, and other analogous accidents. At length several of the craters permanently close, whilst others continue to allow the gas a passage. The more difficult this is, the more the craters become elevated, and the more their funnels contract by the adhesion or coagulation of a portion of the metal. The projection of globules of silver now becomes more violent; the latter being carried to great distances, even beyond the furnace, and accompanied by a series of explosions, repeated at short intervals. It is generally the last of these little volcanos that attains the greatest altitude, and exhibits the foregoing phenomena with the greatest energy. It is moreover observable, that these cones do not all arise at the same time, some having spent their force, when others commence forming at other points. Some reach the height of an inch, forming bases of two or three inches in diameter, and the time occupied by this exhibition is at least half to three quarters of an hour.

During the formation of these cones, by the evolution of gas, portions of silver are shot forth, which assume on induration, a form somewhat cylindrical, and often very fantastic, notwithstanding the incompatibility which appears to exist, between the fluidity of the silver and these elongated figures. Their appearance is momentary, and without any symptoms of gas, although it is impossible to decide whether they may not arise from its influence; they seem, in fact, to resemble the phenomena of the first volcanic period.

These ebullitions, which continue until the metal is completely solidified, appear to me identical with geological phenomena: not a single feature of resemblance is wanting, the rising and falling of the surface, perturbation of the soil, fractures, fissures, volcanos with craters, evolution of gas, and ejection of streams of lava, all these present a remarkable similarity, the difference consisting only in the dimensions.

From the above observations, we may deduce the following comparative results:—

The mass of the globe, as it has been demonstrated by the labour of modern geologists beyond a doubt, was at first in a fluid state, like the silver in question. In consequence of this igneous fluidity, favoured besides by the atmospheric pressure, the earth has absorbed the gases surrounding it. Those possessing powerful affinities, such as oxygen, &c. have combined directly with a portion of the metals and metalloids, and remain united with them; but such as possess only weak affinities, have remained for a longer or shorter period simply condensed, being then emitted at various intervals, and at different points, and will continue to be evolved out until the whole mass in which they are contained in solution shall be solidified, in the same manner as the air combined in water becomes disengaged from it during crystallization or freezing.

In the process above described, the oxygen exhibits too little affinity to remain united with the metal. In the corresponding phenomenon on the terrestrial globe, it is carbonic acid and aqueous vapours which are the most active agents; and consequently we find them abounding in all volcanic regions, whether the volcanos be in activity or not.

Among the gases evolved, azote but rarely occurs. Does this proceed from its being overpowered by too great a surrounding mass? Has it more generally formed combinations producing the results observed in mineral waters, &c.?

Finally, in these phenomena, has the terrestrial mass in fusion, shown a preference for other gases, to the exclusion of nitrogen; as the melted silver in the furnace exhibits no tendency to unite with carbonic acid, or other gases resulting from combustion? I leave geologists to decide these questions.

On the other hand, nitrogen may be disengaged more rapidly than other gases; as copper gives out sulphuric gas before its solidification, and then undergoes a violent ebullition.

The enormous quantity of carbonic acid continually arising in volcanic districts, either with or without mineral waters, might be adduced as evidence of the ancient state of the atmosphere; so rich in this gas, that M. Brongniart attributes to it the vigorous vegetation of the primordial ages; and the circumstances attending the refining of silver, all denote an atmosphere abounding in oxygen.—*Treatise on Geognosy, by M. de Voisin*, vol. iii. p. 277.

PROCEEDINGS OF SCIENTIFIC MEETINGS.

ROYAL SOCIETY.—Nov. 24.

Francis Baily, Esq., Vice-President and Treasurer, in the chair.

The following papers were read:—1. 'Investigation of New Series for the Rectification of the Circle,' by James Thomson, LL.D., Professor of Mathematics in the University of Glasgow; communicated by P. M. Roget, M.D., Secretary to the Royal Society. 2. 'Inquiries respecting the constitution of Salts, or Oxalates, Nitrates, Phosphates, Sulphates, and Chlorides,' by Thomas Graham, Esq., F.R.S. Ed., Professor of Chemistry in the Andersonian University of Glasgow, &c.; communicated by Richard Phillips, Esq., F.R.S. 3. 'Report upon a Letter addressed by M. le Baron de Humboldt to his Royal Highness the President of the Royal Society, and communicated by his Royal Highness to the Council,' by G. B. Airy, Esq. M.A., Astronomer Royal, and S. H. Christie, Esq. M.A.

GEOLOGICAL SOCIETY.—Nov. 30.

Mr. Lyel, President, in the chair.

A paper, "On elevated Beds of Gravel, containing Marine Shells of existing Species, in the vicinity of Dublin," by Dr. Scouler, Professor of Mineralogy of the Royal Dublin Society, was first read.

After a brief account of the physical and geological structure of the country, the memoir proceeded to describe the deposits of shelly gravel at Howth, Bray-head, and Glenismaule. On the south side of the promontory of Howth, and at the point where the calp or limestone approaches the quartz rock, is a deep depression, occupied by an exceedingly tenacious and very ferruginous clay, which also extends across the peninsula, filling up fissures in the limestone. It is unstratified, and does not contain any transported fragments of rock, but numerous nodules of oxide of iron, iron pyrites, and oxide of manganese. Resting upon this clay, the quartz rock and the limestone is a deposit of beds of shelly gravel and sand, extending about half a mile in length, but separated into two portions by the hollow, in which is situated the village of Howth. The highest part of the deposit is about eighty feet above the level of the sea. The gravel consists chiefly of limestone, but fragments of clay slate are not uncommon, and pebbles of granite, quartz rock, flint, and hard chalk occur, though sparingly. The beds of sand are sometimes of considerable thickness, and alternate with the gravel; but this apparent stratification cannot be traced to any distance, the beds thinning out in the same manner as on the existing sea-shores. The shells which have been obtained are seldom perfect, but Dr. Scouler has been enabled to determined, from well characterised remains, seven species, the whole of which are found in a living state in the Bay of Dublin.

A similar accumulation occurs on the south side of the promontory of Bray head, extending for upwards of a mile, and presenting at its northern extremity a vertical section, about 200 feet high, but declining at its southern to the level of the sea. It consists of three deposits, the lowest being composed of clay or marle, the middle of numerous beds of shelly sand and gravel, and the uppermost of angular fragments of granite, or syenite, and quartz rock. The gravel in the central division is made up, for the greater part, of fragments of limestone, but contains pebbles of chalcedony, flint, hard chalk, and a ferruginous conglomerate. The limestone fragments are of moderate size, and are imperfectly rounded, though Bray head is separated from the district in which that rock occurs *in situ* by the whole breadth of the Dublin mountains. It is also worthy of remark, that the fragments of chalcedony, flint, and hard chalk, appear to have been transported from Antrim, and the pebbles of ferruginous conglomerate from Lambay Island, twenty miles to the north of Bray, or the Lyons Hill, on the west of the Dublin mountains.

The shells which have been obtained agree with those in the deposit at Howth.

The third accumulation, particularly described, is in the valley of Glenismaule, through which flows a branch of the Dodder, and is about seven miles from the bay of Dublin. It presents perpendicular cliffs, formed of irregular beds of sand and calcareous gravel, about 100 feet thick, and is probably 200 feet above the level of the sea. It was also above the level of any of the limestone strata of the immediate neighbourhood. Fragments of flint and calcedony occur in the gravel, as well as recent shells, identical with those in the beds previously described.

Accumulations agreeing in the arrangement of the beds, though varying in the nature of the materials, were stated to extend over the whole of Ireland, forming low rounded hills, and filling up previously existing depressions.

No remains of Mammalia have been found in the gravel, except some bones of the Irish elk at Enniskerry, near Dublin.

The following inferences were then given as deducible, from the facts contained in the memoir:—1st, that the coast around the bay of Dublin has been elevated, though unequally, at a comparatively recent geological epoch. 2ndly, that the valley of the Glenismaule, and other valleys, containing similar accumulations of drift, were, at one period, under water, and then filled with the calcareous gravel; and that they were afterwards elevated, and subsequently re-excavated by the action of running water.

The memoir concluded with some observations on the probable source from which the gravel was derived, and the agents by which it was brought into its present position.

A paper was afterwards read, on the Geology of the Thracian Bosphorus, by Mr. Hugh Edwin Strickland, F.G.S., and Mr. Hamilton, one of the secretaries of the society.

The formations described in this memoir consist of a series of beds, considered by the authors to be the identical part of the Silurian system of England, igneous rocks, tertiary limestone, and ancient alluvial accumulations.

The equivalents of the Silurian system occupy both sides of the Bosphorus, for about three-quarters of its length, and extend in a west-north-west and east-south-east direction, to an unascertained distance. They consist of argillaceous schist, brown sandstone, and compact blue limestone, and pass insensibly into each other. Organic remains appear to be extremely local, having been noticed by the authors only in a ravine above Arnaoutkeui, a village about four miles from Pera, on the European side, and at the Giant's Mountain, about fifteen miles from Constantinople, on the Asiatic side of the Bosphorus. They consist, principally, of casts belonging to several species of spirifer, productæ, and terebratulæ, two or three genera of corals, remains of crinoidea, and the eye of an aptychus.

The igneous rocks are composed of trachytes and trachytic conglomerates; the latter being sometimes traversed by veins of cornelian and chalcedony, which intersect both the tufaceous cement and the imbedded fragments. On the Asiatic side of the Bosphorus, they commence *en masse* at Kavak, under the old Genoese castle, and extend to Yoorn-bornou, on the Black Sea, and perhaps further; while on the European side, they commence on the north of Buyukderé, and also extend to the Black Sea. Several trachytic and trap dykes intersect the Silurian formations, but are considered by the authors to be connected with the general mass of igneous rocks. The tertiary formation commences immediately on the west of Constantinople, and ranges along the north coast of the Sea of Marmora for many miles, its western limit being at present undefined. It is best exhibited in the quarries at Baloukli and Makri-keui, where it consists of horizontal beds of soft, white, shelly limestones and marls, resting upon sand in which no fossils have been noticed. Near Constantinople, the deposit was apparently accumulated in an estuary, for it contains, in considerable abundance, a cardium and a cytheres, associated with land and fresh-water shells, some of which resemble existing species.

Along the banks of the Bosphorus, the authors found no traces of a tertiary formation, and consequently infer, that this channel was opened at a comparatively very recent period.

The only ancient alluvium mentioned in the memoir, is an extensive, thick, and unstratified deposit of clay, sand, and gravel, resting upon Silurian rocks. It commences a few miles to the north of Constantinople, forms the subsoi of the Forest of Belgrade, and apparently skirts the southern side of the Lesser Balcan range.

ROYAL GEOGRAPHICAL SOCIETY.—Nov. 25.

Sir John Barrow, Bart., President, in the chair.

Lord Yarborough, Honourable Dudley Pelham, and several other members, were elected, and G. Maclean, Esq., governor of Cape Coast Castle, was proposed a corresponding member. Amongst the presents was a collection of sixty-six volumes of the Nautical Almanac, from Mrs. Marsden; and a series of his splendid charts from Admiral Krusenstern. Captain Washington, the secretary, read a letter from Mr. Davidson, addressed to his brother from Wednoon, dated 25th September. It commenced with the Arabic sentence "Thanks to the one God, there is no power or strength but in him, Amen:" without which it would not have been allowed to pass. A cessation of hostilities had been agreed upon by all the native tribes, in order to allow of their attending the great annual market, and he proposed to take advantage of this armistice by starting three days before its termination on his route, which he considered he might do with perfect safety. His party was to consist of two hundred men and six hundred camels; ten of these would be required to carry his money in cowries, which would not exceed in value 100*l*.; between fifty and sixty more would convey his luggage, and the rest would be laden with salt for commerce. He had taken a short excursion in the desert with the sheick, who continued to be well disposed towards him, when the thermometer on his saddle stood at 140° at noon. His attendant and companion, Abu-Brkr, had been considerably affected by the heat on this occasion. A paper was next read from Captain Vetch, of the Royal Engineers, who has resided for many years in New Spain, descriptive of the antiquities of that country, accompanying which were twenty-four figures on the table. These, with the pyramids, probably belonged to a very remote period, as no epoch or tradition exists by which the date of their erection can be determined, and no opinion can be formed, except from their waste by the action of atmospheric air. The figures were principally of calcareous and siliceous limestone. Many being like the Burmese, and others having a strong analogy with those of the old world, strengthening the conjecture of an extensive intercourse at a former period, by which the habits, manners, and customs, in so many respects, of the inhabitants of both continents were assimilated. Sir John Barrow stated that a letter had been received from the Secretary of the Geographical Society of Paris, announcing that two expeditions were about to sail from France to the Pacific Ocean, the destination of one being to the east and the other to the west. Colonel Jackson, of the Russian service, who was in the room, referred to the progress of geographical enterprise pursued by the Russian Government, amongst which were the expeditions to ascertain the relative levels of the Caspian Sea, and to observe the diminution of the waters in the Baltic, which were now being executed.

BOTANICAL SOCIETY.—Nov. 17.

J. E. Gray, Esq., F.R.S., in the chair.

The meeting was numerously attended, comprising several ladies, members of the society. Many donations of books and plants were announced by the secretary, and thanks ordered to be returned. The laws, as again revised, were submitted, previous to their being printed and distributed to the members; and they are to be confirmed at the general meeting, when the officers also will be appointed. A memoir was then read by A. Irvine, Esq., of Croydon, on the importance of Local Botany. He commenced, by stating, that of the many species of plants found in the world, a small portion only are found in any one country. He stated that Mexico, and the regions of the Andes, are known to contain 6000 species, of which not twelve in number are found in Europe; and the tropical climates are generally much richer in variety of species than the northern regions. He said that 1500 species of flowering plants are to be found wild in Britain, of which about two-thirds are to be found within a circle of twenty-five miles round London. Indeed, this district is by far the best for botanical research of any in the kingdom; and he doubted not that if members would search carefully their own immediate neighbourhoods, much new information would be furnished to the present stock of botanical knowledge, with respect to local botany. Mr. Irvine has himself discovered 670 different species within two miles of Hampstead. Within an equal distance of Croydon, he has found no less than 900 different species, and he has reason to suppose many more grow within the same limits. The species of vascular plants found in Great Britain, comprise nearly all those growing in Lapland and Sweden; three-fourths of those growing in Germany, of which that country is estimated to contain about 2000 different species. The British plants comprise about three-fifths of those found in France, which amount to about 4000; the southern provinces bordering on the Mediterranean furnishing a great part of the number. The Flora of the Presidency of Madras, as hitherto published, contains 2800 species, but the whole of Hindostan is known to contain 8000.

Mr. Irvine made some observations on the state of Chemical Botany, according to him by far the most important branch of the science, but which has hitherto been comparatively neglected, while physiological, systematic, and descriptive botany, have been followed with zeal and success. He further observed, that a great addition has been lately made to the information on this subject by the distinguished Decandolle, in his work on the general medicinal qualities of each family of plants; and he supposed chemical botany was now attracting more attention. Results, he said, of the utmost importance to the welfare of mankind might be expected from further research into the dietetic and medicinal properties of plants. After some remarks on the paper had been discussed, a general meeting of the society was fixed for 29th of November, being the anniversary of the birth of the illustrious English botanist John Ray, which day was also fixed for the anniversary meetings.

Meaning of the Term Cannel Coal.—I observed large quantities of the cannel coal, and took some pains, both here and subsequently at Kendal, St. Helen's, and other places, to obtain the meaning of the term. A considerable quantity is produced at St. Helen's, though the greater quantity comes from Wigan. It is dug out of the same shafts with ordinary coal, but exists in different seams. It appears to be a substance between ordinary coal and jet. In Liverpool and elsewhere, it is advertised by boards and placards—"*coal and cannel sold here.*" It is invariably spelt "*cannel.*" If it have really taken its name from *Kendal*, the people of the town are not aware that it has any such origin; neither is there any reason that it should originally have been called *canal coal*, it having been dug before canals were adopted, and transported together with larger quantities of ordinary coal. It seems to be the general opinion that, having been used to light the men at their work, and serving as *candle*, it became by corruption "*cannel*" coal. It is singular how soon words and phrases creep into use, and totally obliterate every recollection of the cause that produced them.—*Sir George Head's Home Tour through the Manufacturing Districts.*

London: Printed and Published by Henry English, the Proprietor, at his Office, No. 12, Gough-square, Fleet-street, in the city of London; where all Communications and Advertisements are requested to be forwarded, post paid. [December 3, 1836.